seeds being, apparently, produced. Carefully selected arrows from different varieties have produced only about twenty germinating seeds, and of these only four seedlings have been saved and planted out. This is the total result of many trials in the island.

Reviewing agriculture in the West Indies in 1902, the official *Agricultural News* states that solid success attended the efforts to establish industries other than sugar in some localities, the progress made in onion cultivation standing out conspicuously. Both Antigua and Montserrat were able to export considerable quantities of onions, and Dominica and Barbados made satisfactory starts in cultivation. Cotton growing also showed substantial progress, a considerable acreage being under cultivation in Montserrat, St. Lucia and Antigua. At St. Lucia, cotton was grown on 105 acres last year, the whole southern seaboard, about forty-five square miles, being considered excellent soil for cotton, where it can be grown at about one-fourth of the cost of sugar-cane.

TECHNICAL EDUCATION AT HOME AND ABROAD.[1]

A NATION'S view of the expected outcome of its system of education is frequently shown by the recurrence of a typical question. Thus a Frenchman, when considering a young man's qualifications, will naturally ask, What examinations has he passed? A German will ask, What does he know? An Englishman will inquire, What kind of a fellow is he? An American will ask, What can he do? These varied questions reflect the form of education in vogue. In them we see the French tendency to formalism, the German disposition to over-intellectualise their schools, the English love of an all-around gentleman and the American fondness for achievement.

Since the close of the Franco-Prussian war, the development of Germany has been remarkable. Hamburg has risen from the sixth largest port in Europe to nearly the first; German cottons are sold in Manchester, German steel in Sheffield and Leeds, German silks in Paris, and "Made in Germany" is a familiar mark to us. From 1875 to 1895, the population increased from 45,730,000 to 52,250,000. The working energy, during the same period, increased from twenty-five to more than forty-six million foot pounds daily, or about four times as fast as the population. Between 1889 and 1896, the exports from Germany to China increased 86 per cent.; to Japan 92 per cent. The tonnage of German vessels trading with these countries has trebled since 1886 The number of German steamers in 1871 was one hundred and fifty; in 1897 this number had increased to eleven hundred and twenty-five. During the same period, the tonnage increased from 82,000 to 900,000. That Germany has been successful in a commercial way during the past thirty years is not to be denied. Her success can be traced to her belief in the industrial value of scientific research and to her fostering care of the technical education of her people.

From an examination of special industries, we can obtain a clearer idea of this influence. Consider the beet sugar industry. In 1840, 154 000 tons of beets were treated, yielding 8000 tons, or 5½ per cent. of raw sugar. In 1899, with improved scientific processes, 12,000,000 tons were crushed, yielding 1,500,000 tons, or 13 per cent. of raw sugar. This increase of yield from 5½ to 13 per cent. is the direct result of the work of technical men in control of the industry. Not only is Germany no longer dependent upon the West Indies for her sugar, but in one year she has sold Great Britain fifty million dollars worth. The manufacture of alcohol from potatoes is another lucrative field for German technologists. The cost has been reduced to about 25 cents per gallon, and experiments are in progress to determine its efficiency as fuel on steamers. The manufacture of artificial indigo by a chemical process was discovered in Germany in 1866. Less than forty workmen were then employed; now more than six thousand men and a staff of one hundred and forty-eight scientific chemists are employed in the industry. The natural indigo is almost driven out of the market. They have also discovered a method for obtaining from steel processes ground slag which is used as a fertiliser; and England, although she produces quite as much steel as Germany, has become a good customer for the article. Recently there came the discovery, by a chemist, named Giebler, of a process of hardening steel which makes it, it is said, 14 per cent. stronger, 50 per cent. lighter and one-third less costly than the Krupp or Harvey steel. Twenty-five years ago, the English and French makers of scientific instruments of precision were far in advance of the German. However, through the organisation of the Reichsanstalt, an institution for original research and the standardising of instruments, supported by the Government, Germany has become the manufacturer of the best scientific instruments in the world. The value of her exports in this line is nearly 2,000,000 dollars, three times what it was fifteen years ago, and the work gives employment to 15,000 people.

The Germans are fully alive to the necessity of being well prepared to engage in the struggle for industrial supremacy. Prince Bismarck once said: "The war of the future is the economic war, the struggle for existence on a large scale. May my successors always bear this in mind and take care that when the struggle comes we are prepared for it." Bismarck's behest has been heeded. The Germans, by dint of long and thorough preparation, are ready for an economic war. For more than thirty years they have been preparing, and we can see in all directions the steps that have been taken to improve the technical sides of education, so as to produce men who are capable of carrying Germany to the front in this industrial and commercial struggle. The system of German technical schools comprises first a group of Technischen Hochschulen, situated at the capitals of the German States, like those of Berlin, Dresden, Munich and Carlsruhe. These are of the very highest grade, admitting only students who have completed a Gymnasium or Realschule course of study. They have without exception developed gradually from mere trade or building schools. Most of them were founded in the twenties and thirties of last century, and one—the Charlottenburg—was founded as early as 1799. These schools are all beautifully housed, have superb equipments, and are doing a high grade of professional engineering work. Next below them in educational rank comes a great number of trade schools, like the Textile School of Crefeld. These trade schools are located at the centre of the industry to be benefited and are distinctly utilitarian in character. Besides these, there are many continuation and manual training schools. So numerous are these specialised schools that a German can always find one in which he can learn the latest and best principles, devices and methods of any trade or profession he may desire to follow. Add to all these the latest German innovation of commercial high schools and colleges of commerce, then wonder, if you can, why German competition is so keen and why German trade and industry are reaching every market the world over. The Germans have discovered that the secret of success in trade and industry depends upon education; not upon the education of the library and cloister, but upon the education of the laboratory, the shop and the modern lecture room.

Contrast with this the condition of England.

In 1870, Great Britain, exclusive of her colonies, did one-quarter of the world's business, and, including her colonies, 35 per cent. In 1895, her share had fallen to 18 per cent., or, including her colonies, to 31 per cent., showing that while she still held the lion's share, that share was steadily diminishing. From another point of view, a similar tendency can be seen. Between 1870 and 1895, British exports increased only 13 per cent., while during the same period the exports of Russia increased 17 per cent., of France 20 per cent., of Germany 42 per cent., and of the United States 110 per cent., showing that England's commercial advancement during this period was relatively the least of all.

American tools and labour-saving devices are rapidly entering British workshops. One firm recently expended 100,000 dollars in new machinery, two-thirds of which was of American make. In other branches of manufacture, the American and Continental engineers have succeeded in introducing into England many articles which the English imagined, but a short time ago, could not be made cheaper or better than in Great Britain, like electrical machinery, locomotives, steel rails, sugar-producing machinery, and even stationary engines, the pride of the British engineering industry. The year 1901 was noteworthy in that the output of steel in Great Britain fell behind that of the United States by 5,000,000 tons and behind that of Germany by more than a million tons. The machine tool trade is also fast becoming Americanised. In agricultural machinery, the United States is outstripping England with giant strides. In gas machinery, Continental orders are seldom

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[1] Abridged from a paper on the need of technical education, by Prof. Victor C. Alderson, Dean of the Armour Institute of Technology, read before the Chicago Literary Club, October 20, 1902.

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placed in England except for patented apparatus or by gas concerns controlled by British capital. The National Physical Laboratory, the British institution corresponding to the Reichsanstalt of Germany and the U.S. National Bureau of Standards, gets the absurdly small sum of 20,000 dollars per year, while the "beer money" appropriated to technical schools of the second and third rank amounted in 1898–9 to 4,152,000 dollars and in 1899–1900 to 4,380,000 dollars.

That there is "something the matter" with English economics seems evident to an impartial observer. Public opinion is slowly awakening to a realising sense that in some unseen manner England is being fed, clothed, reorganised and educated by foreigners. Prominent Englishmen, whose warnings are sincere, are trying to tell her that decline is at hand unless she adopts a sweeping reform in the whole content of her educational system, so as to bring it into close relationship with present-day necessities.

The Englishman learns slowly; he prefers to use methods formerly successful in spite of the fact that they are inapplicable to-day; he is slow to disturb established tradition and can scarcely be made to believe that any new forces have entered into the struggle for industrial supremacy. The rest of the world is learning the value of technical training in its varied forms as a foundation for industrial success, but the English still cling to their antiquated ideas. England has not kept alive to the requirements of the new scientific age into which we are now being thrust; she has not recognised the close connection that exists between science and industry; she is, as it were, using mediæval methods in modern industrial warfare; by neglecting the technical education of her people, she has failed to train her industrial army. This alone explains at once her own decadence and the advance of Germany and the United States.

The educational status of England is far lower than many suppose. We are pleased to juggle with the names Eton, Rugby, Oxford and Cambridge, but we must remember that these schools are only for the highest social classes and are maintained to educate the English gentleman of rank, not the plain everyday Englishman, and have little or no good influence upon industrial or commercial life. Through their graduates, who influence much of the editorial writing in London, they are seriously impeding the advance of correct ideas by their ultra conservatism and even ignorance of the scientific spirit of the age. The whole trend of an Oxford or Cambridge education is away from the masses. The primary and grammar schools of England are not only weak and inefficient, but are partly under State and partly under religious control; public high schools, as Americans know them, are non-existent; the higher college and university training is mostly classical and out of harmony with modern necessities; technical education, which in Germany and the United States must be preceded by a good high-school course of study, follows in England a weak grammar school education. Outside of her college preparatory schools and her two universities, which reach only an exceedingly small fraction of her people, England provides educational facilities which are utterly inadequate, both in character and extent, to the enormous needs of her people. To a certain extent, the view of Dr. Johnson still prevails that education is "needed solely for the embellishments of life and is useless for ordinary vermin."

The temper of the British mind is against scientific and technical progress. Research work, which is really the guiding star for all human progress, is sadly neglected. New ideas are imported from Germany and the United States; they seem unable to germinate on British soil. London, which was the first city to be lighted by gas, is the last to accept electricity. Germany teaches England electrochemistry and the United States gives her lessons in electric traction. Low-grade technical schools, evening schools and polytechnics she has in abundance; but they train only the imitative, not the creative faculties. England hates the specialist; Germany glories in him. England relies upon the practical man; Germany upon the technically trained man. England exalts the "rule-of-thumb" method; Germany insists upon scientific accuracy. England has no national system of education; Germany has a highly organised, Government-controlled system; England places her technical training next above a weak elementary education; Germany, believing in specialised education, which must be concerted and not premature specialisation, places her technical training after a thorough general education.

The race for industrial supremacy is on; the first three places are undoubtedly held by England, Germany and the United States. In view of the need of economic progress, it is not difficult to see that the outcome of the feeling of unrest which now pervades the educational world will be the enlargement of the sphere of technical education. All the signs of the times point in this direction. The trained technical man is rapidly taking the place of the untrained man. No nation can successfully oppose this world-wide movement. When the philosophers, educators and economists have risen to a full comprehension of the meaning of the present world-wide educational unrest, they will see that the solution of their doubts and anxieties lies in a fuller and more comprehensive development of the sphere of technical education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Saturday last, Mr. H. Brereton Baker, F.R.S., Balliol College, was elected to the Lees readership in Chemistry, which had become vacant owing to Mr. Vernon Harcourt's resignation. Mr. Baker came up to Balliol as a Brackenbury scholar in 1880, and took a "first" in natural science in 1883. He was a pupil of Prof. Dixon, at that time lecturer in chemistry at Balliol, and he also worked under Mr. Harcourt at Christ Church. On leaving Oxford, Mr. Baker went to Dulwich, where he remained until last May, when he was appointed head-master of the Alleyn's School. His election is naturally very popular, and Oxford will gladly welcome back one of her most distinguished chemists, particularly one who has shown that the duties of a schoolmaster are not incompatible with the carrying on of research.

On Saturday, February 14, a meeting of the resident members of the University who are interested in the teaching of natural science will take place in the examination schools to meet a deputation from the Association of Public School Masters, consisting of Mr. H. B. Baker, of Dulwich, Mr. Hill, of Eton, Mr. Sclater, of Charterhouse, and Mr. Shenstone, of Clifton. The following proposals of the association, respecting entrance scholarship examinations to the universities, will be brought before the meeting:—(1) That the science part of the examination should consist of (*a*) a paper on elementary physics and chemistry for all candidates; (*b*) papers and practical work in not more than four subjects: (i.) physics; (ii.) chemistry; (iii.) botany and zoology; (iv.) geology. Of these subjects, candidates must not offer more than two. (2) That very marked excellence in one of the four advanced subjects should have due weight.

CAMBRIDGE.—Mr. T. Manners-Smith, Downing, and Dr. Marett Tims, King's, have been appointed additional demonstrators of anatomy.

Mr. W. A. Cunnington, Christ's, has been appointed to work at the University table in the Naples Zoological Station.

The Library Syndicate report that the cost of providing suitable accommodation and catalogues for the Acton Library, presented by Mr. John Morley, will amount to more than 7300*l.*

Dr. MacAlister, Prof. Woodhead and Dr. Nuttall have been appointed to represent the University at the Brussels Congress of Hygiene and Demography, to be held next September.

The following have respectively been appointed electors to the professorships named:—*Chemistry*, Dr. T. E. Thorpe; *Plumian of Astronomy*, Mr. W. H. M. Christie; *Anatomy*, Dr. T. C. Allbutt; *Botany*, Mr. A. Sedgwick; *Geology*, Dr. S. F. Harmer; *Jackson of Natural Philosophy*, Lord Rayleigh; *Downing of Medicine*, Dr. A. Macalister; *Mineralogy*, Prof. J. J. Thomson; *Zoology*, Dr. D. MacAlister; *Experimental Physics*, Lord Rayleigh; *Mechanism*, Mr. O. Reynolds; *Physiology*, Prof. G. S. Woodhead; *Surgery*, Dr. A. Macalister; *Pathology*, Dr. W. H. Gaskell; *Agriculture*, Dr. W. Somerville.

Sir James Blyth, Bart., has been appointed a member of the Board of Agricultural Studies.

DR. VICTOR LEBEUF, of the University of Montpellier, has been appointed director of the astronomical observatory at Besançon, and Dr. Marcellin Boule to the professorship of palæontology at the Paris Natural History Museum.

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